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DEVELOPMENT OF A FULL PRESSURE SUIT CONTROL SYSTEM FOR ALTITUDE CHAMBER OPERATIONS

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SUMMARY PAGE

THE PROBLEM

To devise a remote control system for full pressure suit operations at simulated altitudes.

FINDINGS

A remote control system composed of two units which can be installed in existing altitude chambers has been developed. This system allows interchangeability with existing training equipment to accomodate a full pressure suit operation with minimum alterations.

INTRODUCTION

With the advance of the full pressure suit from the experimental stage to the operational stage came the requirement for research and training under simulated conditions prior to the actual "in-flight" mission.

The low pressure chamber is ideally designed for the simulation of the conditions of reduced atmospheric pressure and with a few minor additions and alterations can be easily adapted to the needs of a full pressure suit operation. The conversion of an entire altitude chamber to accommodate the full pressure suit is not desirable, but rather a system is needed to allow interchangeability with existing training and test equipment.

Such a system is the subject of this report. The following is a description of a remote control system which can be placed in operation in any existing altitude chamber. This system can be installed with a minimum of additional equipment and can be quickly installed or removed from the chamber as required once the basic installation is completed.

TECHNICAL DESCRIPTION

The remote control system is composed of two units. Unit A is the interior unit which is installed in the altitude chamber and can be quickly removed so as not to interfere with other operational commitments. Unit B is the exterior unit which is installed exterior to the altitude chamber and is normally a semi-permanent type of installation in the sense that it need not be removed for other operations or, if required, can be eliminated by simply disconnecting its service connections and sealing them without interference to existing chamber installations. The service connections for both units require a compressed air source and oxygen source. Most altitude chambers already have both of these as part of their existing equipment.

The exterior unit (Figure 1) consists of a 1/2-inch plywood panel which measures 20-1/2 inches x 32 inches attached to a metal mounting bracket. An aircraft altimeter and rate of climb indicator are mounted on this panel which indicate chamber altitude and ascent rate. A mercury altimeter attached to the panel is used to indicate the altitude of the pressure suit. Ventilation air flow to the suit is controlled by a 1/2-inch needle valve mounted beneath a flowmeter. Also located on the console is an oxygen pressure reducer assembly.

The service connections for the units are located on the rear of the external control panel. Oxygen is carried to the oxygen pressure reducer via a 5/16-inch copper tubing from the main oxygen supply bank located near the altitude chamber. Air is carried to the needle valve via a 1/2-inch galvanized pipe from the air compressor adjacent to the altitude chamber. A filter is located between the air compressor and needle valve to prevent dust and moisture from entering the valve and flow meter, and a pressure gauge has also been placed in the 1/2-inch line to indicate air pressure. The ventilation air is carried from the flow meter via the 1/2-inch galvanized pipe through the chamber wall to the interior panel.

Three 5/16-inch copper tubes leave the rear panel and enter the chamber wall through a common penetration (Figure 2). One carries oxygen from the pressure reducer assembly to the interior unit; the second is attached to the mercury manometer, and the third connects through a "Tee" tube to the aircraft altimeter and rate of climb indicator.

The interior unit (Figure 3) consists of a 1/2-inch plywood panel, measuring 21 inches x 28 inches, which is attached to a metal mounting bracket designed for rapid disengagement from the altitude chamber mounting receptacle. Mounted on the upper portion of this panel are two standard aircraft altimeters and a pressure gauge (0-5 psi). One altimeter records chamber altitude and the second records suit altitude. The pressure gauge indicates suit pressure.

The lower portion of the interior panel contains: 1) an oxygen pressure reducer assembly, 2) a service connection for oxygen to the pressure suit helemt, 3) a vent air service connection, 4) the suit exhaust air hose, and 5) a fitting for the sensing line from the suit. The vent air and suit exhaust connections were modified by a pressure plate to prevent activation of the quick disconnect feature.

The full pressure suit controller is located on the rear of the interior panel with the service connections for the associated equipment. The 5/16-inch copper oxygen line is attached to the oxygen pressure reducer, and a flexible hose carries oxygen from the pressure reducer to the suit controller. A second flexible hose from the pressure reducer carries oxygen to the pressure suit helmet line.

Ventilation air carried via the 1/2-inch galvanized pipe passes into an air filter mounted on the chamber wall. From this filter a 1/2-inch high pressure hose carries the air to the ventilation air service connection on the panel.

The suit exhaust air is carried from the service fitting on the panel to the suit controller by a short corrugated flexible hose (Figure 4). The sensing line, which is a small 3/16-inch high pressure rubber hose running from the modified suit exhaust port, is connected to a 5/16-inch copper tube at the service connection on the panel. The 5/16-inch tube transmits suit pressure through a "Tee" fitting to the line joining the mercury altimeter on the exterior panel and to the pressure gauge and suit altimeter located on the interior panel.

COMMENTS

With the use of existing equipment available for operation and maintenance of the U. S. Navy Mark IV Full Pressure Suit, a remote control system has been developed. This system allows for positive control of both breathing oxygen and suit ventilation air at a point distant from the actual location of the suit. Training and testing procedures require that the suit be operated at simulated altitudes within the confines of a low pressure chamber. From a safety standpoint, positive control of the operation should be conducted exterior to the altitude chamber to free control personnel from the rigors of reduced pressure.

This system also incorporates the feature of a dual position monitor; that is, the control personnel have the capability to visualize the interior console for a direct readout of chamber and suit altitude and suit pressure through the altitude chamber observation port. When visulization of the interior console is not practicable, direct readout of chamber and suit altitude is accomplished at the exterior control console.

This remote control system was initially designed to effect a positive control of pressure suit conditions and allow for direct monitoring of both chamber and suit during training procedures while at simulated altitude. The system also has been useful during various research and test procedures requiring measurement of suit pressure, oxygen, and ventilation air flow.

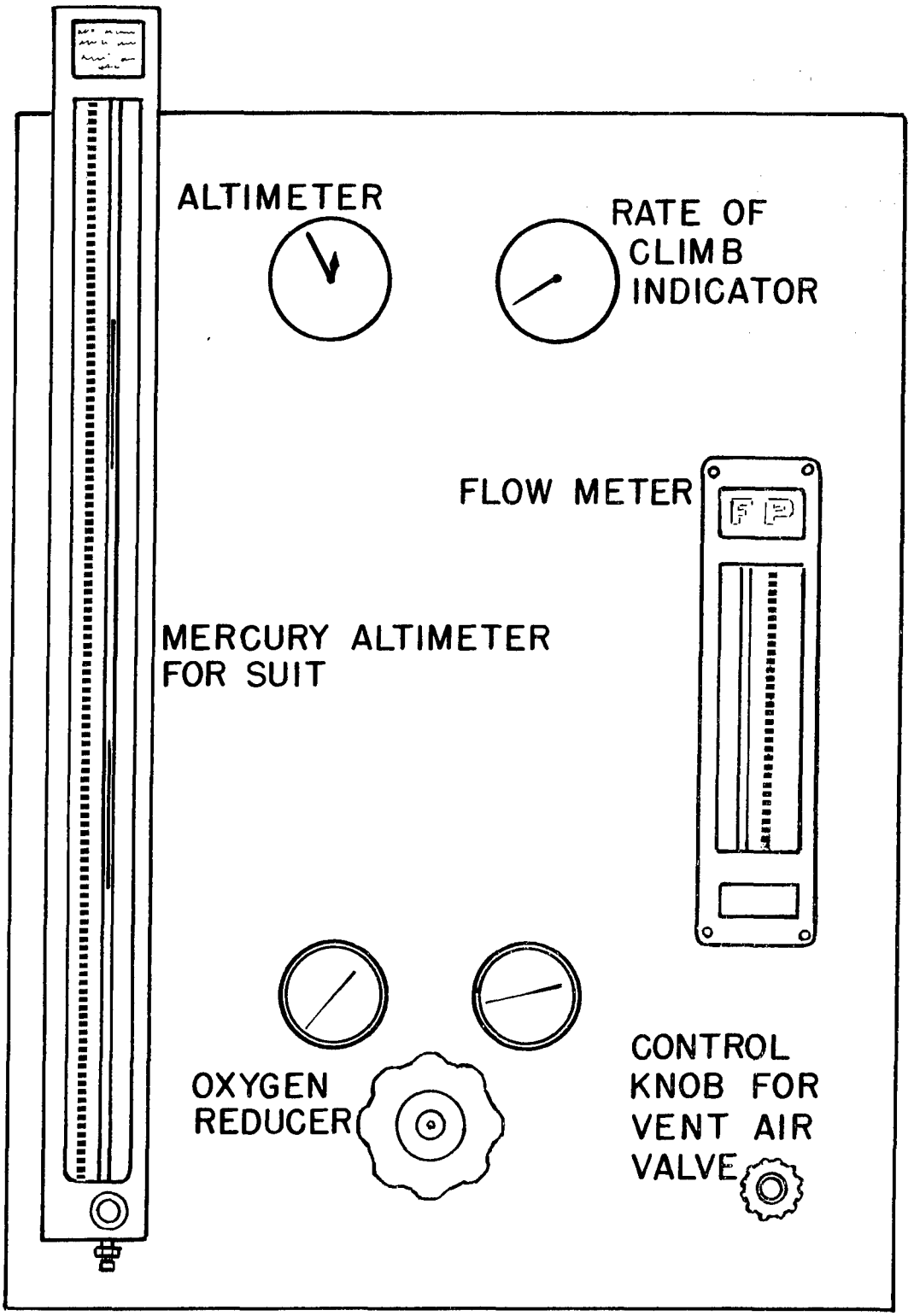

Figure 1

Exterior Panel
(Unit B)

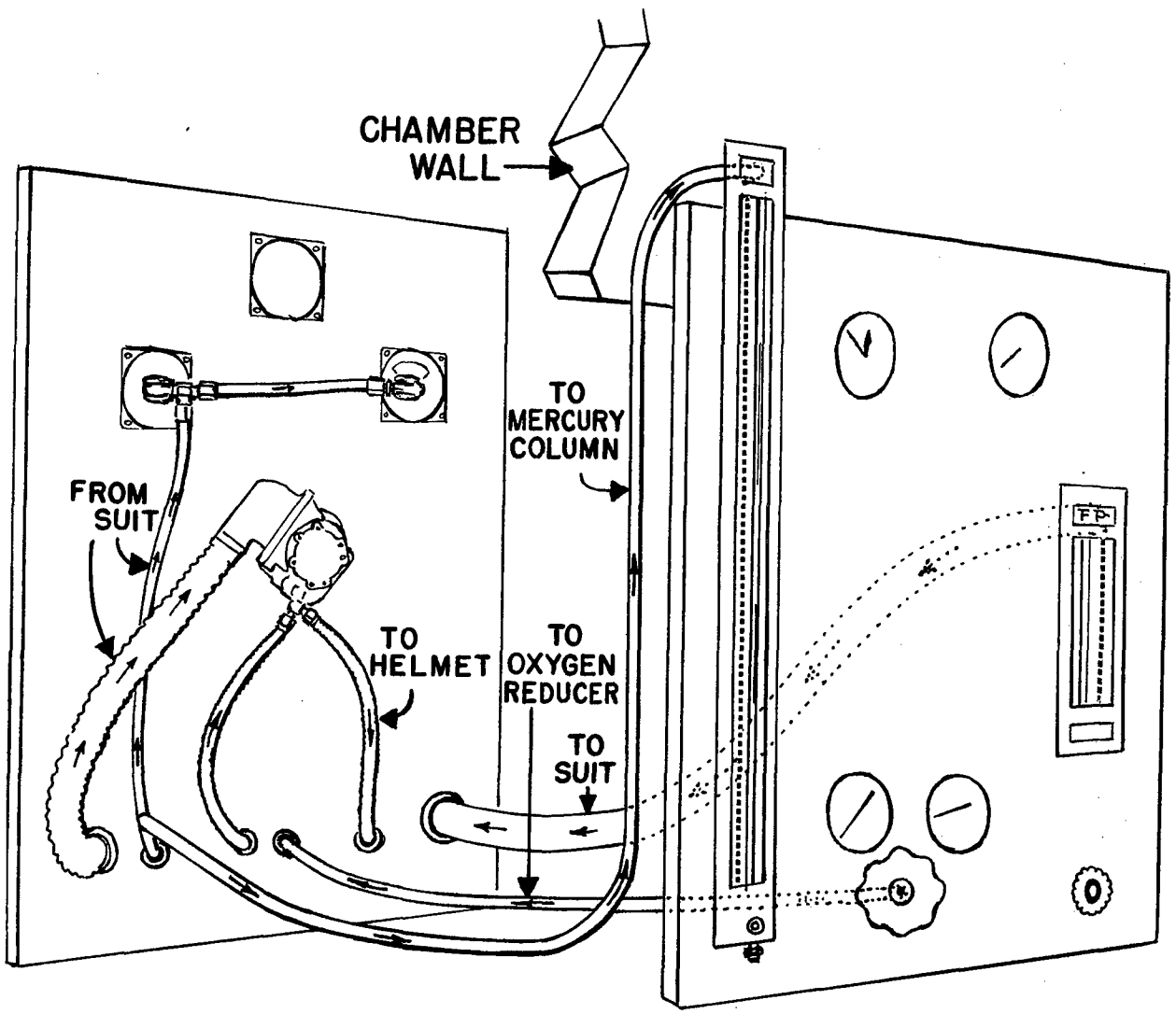

Figure 2

Diagram to Show Mating of Exterior Panel to Interior Panel

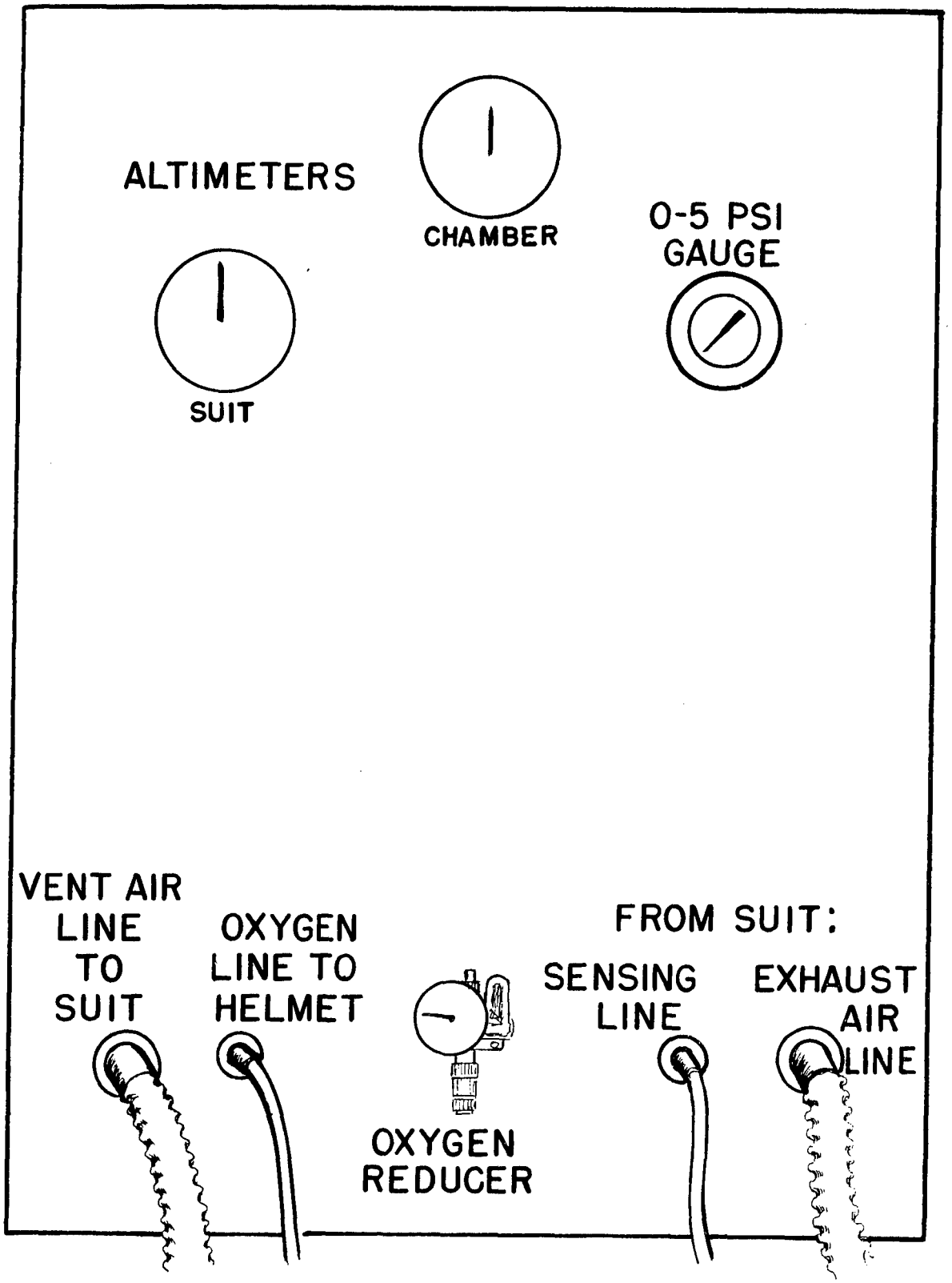

Figure 3
Interior Panel
(Unit A)

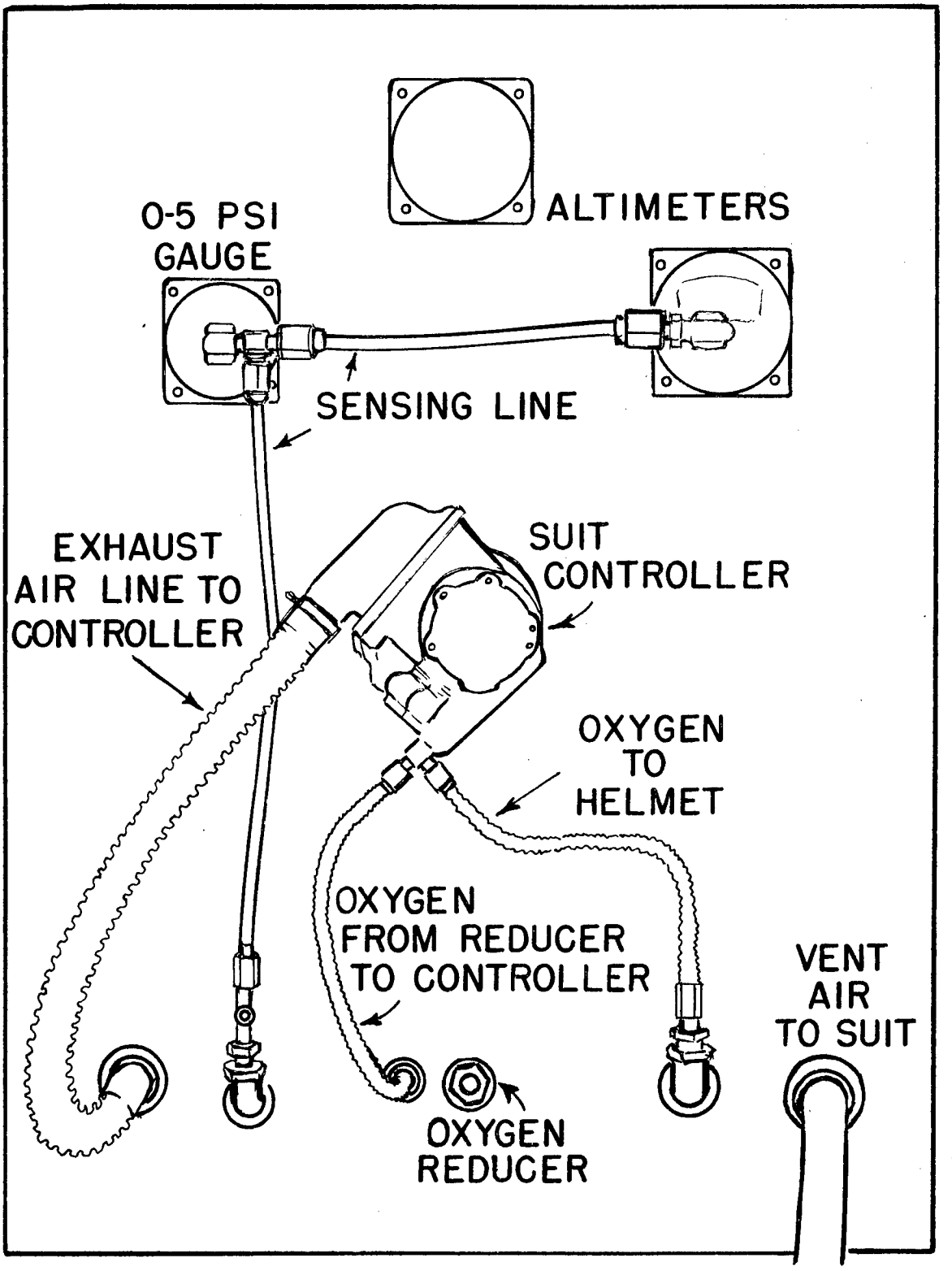

Figure 4

Rear of Interior Panel Showing Suit Controller and Associated Fittings